USE OF ELECTRONIC HEALTH RECORDS TO AID IN PEDIATRIC OBESITY DIAGNOSIS

A Thesis

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Master of Science in Health Informatics

by

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ABSTRACT

Background: Obesity has recently been classified by the American Medical Association (AMA) as a disease which, if unrecognized and unaddressed in childhood, causes multiple medical and psychological complications that can impact both personal and population health. Unprecedented funding is being invested in electronic health records to improve quality, safety, and delivery of healthcare and reduce healthcare costs. Scant literature has evaluated the use of aids in the electronic health record (EHR) to identify obesity.

Objectives: The purpose of this study was to determine to what extent the tools available in an EHR for automatic Body Mass Index (BMI) calculation based on height and weight documentation are used by pediatricians to correctly identify obesity in children. Secondary objectives were to evaluate quality of data input (discrete vs. free text) and see if there is any variation in rates of identification among patients of different socio-demographic characteristics and trainees of different levels.

Methods: We conducted a retrospective chart review for patients aged 2–18 years seen for a well-child visit at New York Presbyterian Hospital between January 2011 and January 2014, where it is standard practice at these visits to take height and weight measurements. The EHR automatically populates these values onto growth curves, converting them into BMI with percentiles. Standardized definitions from the Centers for Disease Control and Prevention (CDC) 2010 were used to qualify overweight and obese based on BMI. We determined the percentage of patients who were overweight or obese (based on CDC percentiles) that had the diagnosis identified by the pediatrician, and then assessed the quality of data input. We assessed laboratory

follow up and referrals for all patients, and assessed for demographic differences among patients properly and not properly documented by providers as obese or overweight.

Results: We reviewed 700 charts in total. Inclusion criteria were all of the patients who had a BMI between 85–95% (these were grouped as overweight) and a BMI over 95% (obese). 209 patients were overweight or obese and therefore eligible for inclusion. Of the 209 clinically overweight/obese children, 72.2% had some form of documentation of this diagnosis, although the diagnosis was documented more often in the obese vs. overweight child. The diagnosis was most often captured electronically in the free text progress note. Over half of clinically overweight/obese children aged ≥8 years did not receive follow-up standard laboratory testing, and only about one-quarter of clinically overweight/obese children had documented in-office nutrition guidance. Diagnosis of overweight was higher in females, but it was almost twice as likely that an obese male would be documented as such. Results showed no identification variation based on age or race/ethnicity. There was no difference in recognition of obesity/overweight based on postgraduate year (PGY) or nurse practitioner (NP) status.

Conclusion: Despite its importance as a public health priority for children, automatic calculation of BMI by use of an EHR led to documentation by a provider as a child being overweight/obese only three quarters of the time. This study suggests that despite increasing focus on using EHRs to improve individual and population health, including for obesity, clinical decision support remains underutilized.

BIOGRAPHICAL SKETCH

Virginia Wenzel is currently a student at Weill Cornell Medical College pursuing a Master's of Science degree in Healthcare Informatics.

Virginia graduated from St. John's University with a Bachelor of Science degree in Pharmacy. She is currently a registered pharmacist. After graduation, Virginia worked as a clinical pharmacist in a hospital setting. She then became manager of a compounding pharmacy, practicing both human and veterinary medicine. Virginia received a certification in publishing with a focus in editing from New York University and spent several years as a medical editor, writing prescribing guides, contributing pharmaceutical content to medical articles, and writing continuing medical education materials. Virginia expanded her career to healthcare informatics, playing an active role in implementation of the electronic health record at multiple hospitals and ambulatory practice. She is experienced in several vendor applications, and is certified in decision support. Virginia hopes to expand her role as a key decision maker in the informatics circle, focusing on advancing population health by applying technology to improve outcomes.

To my family

For always supporting me to achieve my dreams

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LIST OF ABBREVIATIONS

AMA	American Medical Association
EHR	electronic health record
BMI	Body Mass Index
CDC	Centers for Disease Control and Prevention
PGY	postgraduate year
NP	nurse practitioner
CAH	critical access hospital
HIT	health information technology
IT	information technology
ICD	International Classification of Diseases
EP	eligible provider
USPSTF	U.S. Preventive Services Task Force
AHRQ	Agency for Healthcare Research and Quality
CDS	clinical decision support

INTRODUCTION

In 2013, the AMA officially recognized obesity as a disease state, underscoring that fact that, if unrecognized and unaddressed in childhood, it causes multiple complications that can impact health throughout life. This includes cardiovascular disease, increased risk of both fatal and non-fatal myocardial infarction, decreased insulin sensitivity, fatty liver, sleep apnea, asthma, osteoarthritis, and possibly depression (1-12). These symptoms can be seen not just in adulthood but also in childhood. The dramatic increase in rates of obesity makes this an urgent national health issue.

Since 1980, the rate of obesity in children and adolescents has almost tripled. A study of children aged 3–5 years between 2007 and 2010, reports that 12.4% of boys and 10.0% of girls had a BMI $\geq 95^{th}$ percentile. These statistics remain constant through August 2013, when 1 in 8 (12%) of preschoolers in the United States is obese. Children who are overweight or obese as preschoolers are 5 times as likely as normal weight children to be overweight or obese as adults. (13)(13)(13)(13)(13)(1) By 2014, nearly one-third of children struggle with overweight and obesity. If obesity rates stay consistent, by 2030, 51% of the population will be obese. While twenty years ago, no state had an obesity rate above 15%, today there are 41 states with obesity rates over 25%. (13-17)

Beyond the personal and population level health effects, the financial cost associated with obesity is a major concern. In 2010, the nonpartisan Congressional Budget Office reported that nearly 20 percent of the increase in U.S. health care spending (from 1987-2007) was caused by obesity. (18) Annual health costs related to

obesity in the U.S. is nearly $200 billion, and nearly 21 percent of medical costs in the U.S. can be attributed to obesity. (19) Researchers estimate that if obesity trends continue, obesity related medical costs, alone, could rise by $43 to $66 billion each year in the United States by 2030. (20) Per capita medical spending is $2,741 higher for people with obesity than for normal weight individuals. (21) And all of this might be thwarted if we are proactive in childhood.

Despite its prevalence and significant public health burden, obesity is underdiagnosed. A retrospective medical record (paper chart) review of 2515 health supervision visits for obese children aged 3 months to 16 years found obesity was diagnosed correctly only 53% of the time. Another review of paper charts of North Carolina Medicaid enrollees aged 3 to 5 and 13 to 16 years, found that in the 3 to 5 year old cohort, BMI was recorded only 22% of the time, plotted on growth charts only 24% of the time, and documented only 10% of the time. For the adolescent cohort, BMI was recorded only 21% of the time, plotted on growth charts only 20% of the time, and documented only 12% of the time. In a third study of health maintenance visits for children aged 3 to 17 years, among 600 patients, overall 39.8% were at risk of overweight or were overweight, but the BMI was documented only in 0.5% (N = 3) of medical records. Among the 239 children at risk of overweight or overweight, only 20.5% of the patients at risk had a documented diagnosis of overweight and 16.9% had documented treatment. (22) The American Academy of Pediatrics recommendations include lipid profile, total cholesterol level, and type 2 diabetes mellitus screening. Evaluation and treatment for those identified as obese often does not adhere to these recommendations. (23, 24)

Many of the above referenced studies examined identification and follow up of obesity using paper charts. This can be challenging for many reasons. For example, trends can

be missed if documentation involves isolated growth points. Paper charts also lack decision support to aid clinicians in next steps, such as point of care testing and referrals. One tool that may be helpful in improving identification and care of obese patients is electronic health records. Unprecedented funding is being invested in electronic health records to improve quality, safety, and delivery of healthcare and reduce healthcare costs. The Medicare and Medicaid Electronic Health Care Record (EHR) Incentive Programs provide incentive payments to eligible professionals, eligible hospitals, and critical access hospitals (CAHs) as they adopt, implement, upgrade or demonstrate meaningful use of certified EHR technology. With regard to its use in tackling obesity, an eligible professional Core Objective in 2013 Stage 1 Meaningful Use required the provider to record and chart changes in height, weight, and blood pressure, calculate and display BMI, and plot and display growth charts for children 2–20 years, including BMI. Importantly, EHRs generally allow for automatic electronic calculation of BMI and growth chart documentation from discretely documented height and weight information.

To date, scant literature has evaluated the use of EHRs to identify and help manage obesity in patients. A systematic review of studies that utilized health information technology (HIT) to deliver obesity screening or treatment to children aged 2 to 18 years from January 2006 to April 2012 evaluated its impact on patient outcomes (BMI, dietary or physical activity behavior change) or care processes (BMI screening, comorbidity testing, diet, or physical activity counseling). The study concluded that EHRs show promise in assisting physicians to adhere to clinical guidelines for screening, but highlighted the need for further research to evaluate if changes in care processes will affect clinical outcomes and if additional information

technology (IT) applications can enhance the quality and availability of screening and treatment. (25)

Thus, the primary objective of this study is to determine to what extent obesity, when indicated by the electronically calculated BMI using an EMR with growth charts, is correctly documented by International Classification of Diseases (ICD) 9 code as an Encounter diagnosis, documented in the Problem List, mentioned in the Progress Note, or left undocumented, comparing these rates to historical controls. The secondary objectives are to evaluate the quality of data input (discrete vs. free text), to see if there is any variation in rates of identification among patients of different socio-demographic characteristics, as well as to see if there are differences among trainees of different levels, as the study setting is a resident group practice clinic. This study adds to the limited literature in the important context of rising obesity rates and more widespread adoption of EHRs in recent years. Understanding how EHRs may or may not be effective in improving care around obesity is important to guide future system design efforts, educational campaigns for clinicians, as well as future public health policies in this area.

This research is also unique in that it is the only study to our knowledge that has looked at documenting and managing obesity using EHRs among resident trainees. Prior studies of BMI screening using electronic decision support tools have only looked at office-based practices and private practice physicians. Thus, this work can make important contributions to the field of graduate medical education by exploring how well residents, who are increasingly training in an era of EHRs, are utilizing these tools effectively to diagnose and manage one of the most common health problems in pediatric patients.

CHAPTER 2

METHODS

2.1 Study Design and Setting

We conducted a retrospective cohort study of children 2-18 years of age seen for a well-child visit at the pediatric resident group practice clinic at New York Presbyterian between January 2011 and January 2014. The Resident Group Practice clinic (part of the Ambulatory Care Network of New York-Presbyterian Hospital), is a medical home for children who live in all boroughs of the city. Over 90% of patients who receive care at the clinic have either Medicaid or Child Health Plus as insurance. The patient population is diverse: half of the patients are non-white and the majority is of Hispanic ethnicity. Approximately 40 residents staff the practice with 10 faculty serving as practice preceptors. Patients are always seen first by a resident, followed by presentation to a faculty advisor, or independently by a single nurse practitioner. There are approximately 12,000 patient visits each year.

The clinic uses one of the most widely utilized vendor based ambulatory EHR systems, Epic, for all clinical activities. Epic has been in place in the clinic for over 5 years. For well child checks, all children have height and weight measurements documented electronically, with automatic BMI calculation and growth chart documentation.

2.2 Study Subjects

Study subjects included any patients who presented for a well check that met the definition of overweight or obese, using standardized definitions from the CDC (2010). According to these definitions, any patient with a BMI between 85–95% for age is considered overweight and any patient with a BMI over 95% is considered obese. All other patients were excluded.

2.3 Data Items Collected

For patients who met inclusion criteria, we collected demographic data included gender, age, race if available, height, weight, and BMI. Additionally, it was evaluated as to whether the provider documented that the patient was overweight/obese, and, if documented, how it was recorded (ICD9/10 billing code, progress note, and/or problem list). If overweight/obesity was documented, the chart was reviewed to determine what, if any, evaluation was done (specifically performance of: hemoglobin A1c, blood glucose, lipids, thyroid profile, or serum insulin). It is standard of care in this practice for children over the age of 8 to have obesity labs performed annually. The medical record was also reviewed to see if these tests had been performed recently, and for historical and/or new related co-morbidities. Interventions such as referral to nutrition, referral to endocrinology, and referral to the Health for Life program (a comprehensive obesity management program) were noted. We also noted if the patient was seen by a resident or nurse practitioner, and the postgraduate year of that resident.

2.4 Analytic Plan

The report of pediatric well exam visits was coded to protect identifiers from improper use and disclosure. Electronically recorded data was kept on a password-

protected hard drive. A linking key was created for both study subjects and for providers. We immediately destroyed the linking key upon completion of the study. All charts were reviewed for prevalence of overweight/obesity (BMI≥85% based on CDC guidelines). Only charts meeting inclusion criteria were further reviewed for documentation criteria.

2.5 Statistical analysis

Descriptive statistics (frequency and proportion) were used to describe patient characteristics (age, gender, and race) as well as provider characteristics (PGY/NP status).The Pearson chi-square test was used to compare differences in descriptive characteristics between overweight and/or obese children. A one-sample chi-square test was used to determine differences in the number of diagnostic criteria met among overweight and/or obese children. McNemar's test for Correlated Proportions was used to examine how documentation differed as a function of discrete vs. free-text. All p-values are two-sided and evaluated at the 0.05 alpha level. All analyses were performed in SAS v9.3 (SAS Institute, Cary, NC).

CHAPTER 3

RESULTS

3.1 Study Subjects

Records were reviewed for 700 children 2-18 years of age who presented for a well-child visit at the pediatric resident group practice clinic at New York Presbyterian between January 2011 and January 2014. After reviewing 700 well visit encounters, 29.9% of patients had a BMI indicative of overweight or obese (16.45% overweight; 13.45% obese). The youngest patient in our study was 24 months while the oldest was 18 years. The majority of overweight and obese patients were male. Nearly 20% of patients were seen by a single nurse practitioner. The remainder were seen predominantly by second and third year residents (see Table 1).

Table 1. Demographics of Patient and Provider

Patient Characteristics	Overall (N=209)	Overweight (N=102)	Obese (N=107)	P-value
Gender				0.0338
Male	114 (54.6)	48 (47.1)	66 (61.7)	
Female	95 (45.5)	54 (52.9)	41 (38.3)	
Age				0.4325
0-5	68 (32.5)	37 (36.3)	31 (29.0)	
6-10	59 (28.2)	29 (28.4)	30 (28.0)	
11-13	53 (25.4)	21 (20.6)	32 (29.9)	
14+	29 (13.9)	15 (14.7)	14 (13.1)	
Race/ethnicity				0.2595
Hispanic	84 (40.2)	37 (36.3)	47 (43.9)	
Non-Hispanic	125 (59.8)	65 (63.7)	60 (56.1)	
Provider Characteristics				
PGY Status				0.8034
1	14 (6.7)	6 (5.9)	8 (7.5)	
2	70 (33.5)	36 (35.3)	34 (31.8)	
3	82 (39.2)	40 (39.2)	40 (39.3)	
4	2 (1.0)	0 (0)	2 (1.9)	
NP	41 (19.6)	20 (19.6)	21 (19.6)	

3.2 Primary Objective

3.2.1 Documentation of Overweight/Obese

We found that of the 209 clinically overweight/obese children, 72.2% had some form of documentation of this diagnosis in their chart. This included 86% of obese children but only 55.9% of overweight children. Only 45.5% were documented as overweight and obese by ICD 9/10 billable codes, 60.8% by Progress Note documentation, and 17.2% by the Problem List (see Table 2).

Table 2. Extent of Documentation of Overweight/Obese

		ANY FORM OF DOCUMENTATON	ICD9/ICD10	Progress Note	Problem List
	N	N (%)	N (%)	N (%)	N (%)
Overall	209	151 (72.2)	95 (45.5)	127 (60.8)	36 (17.2)
Overweight	102	57 (55.9)	27 (26.5)	49 (48.0)	10 (9.8)
Obese	107	92 (86.0)	68 (63.6)	78 (72.9)	26 (24.3)

Children who are overweight and/or obese do not have this diagnosis equally documented by all available diagnostic criteria ($p<0.0001$) (see Table 3).

Table 3. Differentiation of Diagnostic Criteria for Overweight/Obesity Diagnosis

	N	0 criteria	1 criteria	2 criteria	3 criteria	P-value for equal proportions
Overall	209	58 (27.8)	64 (30.6)	67 (32.1)	20 (9.6)	<0.0001
Overweight	102	45 (44.1)	30 (29.4)	25 (24.5)	2 (2.0)	<0.0001
Obese	107	13 (12.2)	34 (31.8)	42 (39.3)	18 (16.8)	0.0001

3.2.2 Lab Testing

Overall, 54.7% (N = 117) of clinically overweight/obese children aged ≥8 years did not receive follow-up laboratory testing. Specifically, 70.6% (N = 51) of overweight children and 42.2% (N = 66) of obese children had no laboratory follow-up testing. The difference between groups was statistically significant ($p<0.0024$).

3.2.3 Referrals

Only 26.8% of clinically overweight/obese children had documented that they received in-office nutrition guidance, with 11.5% being referred to nutrition counseling or the available Health for Life program. While only 4.3% of clinically overweight/obese children had documented referral to endocrinology, this referral was greater than 7 times more frequent in obese children.

3.2.4 Comorbidities

Obesity-related comorbidities were already present in 18.7% (N = 209) of overweight/obese patients. 13.7% (N = 102) of overweight patients had existent comorbidities; 23.4% of obese patients had existent comorbidities (see Table 4).

Table 4. Comorbidities

		Weight		
	Overall (N=209)	Overweight (N=102)	Obese (N=107)	P-value
Co-morbidities				0.0738
Yes	39 (18.7)	14 (13.7)	25 (23.4)	
No	170 (81.3)	88 (86.3)	82 (76.6)	

Table 5. Related Comorbidities

Comorbidity	Overweight (# events)	Obese (# events)
Hypertriglyceridemia	5	1
Elevated HgA1c	4	5
Hyperlipidemia	2	3
Insulin resistance	0	4
Elevated blood pressure	3	6
Metabolic syndrome	0	1
Type 2 Diabetes Mellitus	0	1

3.3 Secondary Objectives

3.3.1 Patient socio-demographic characteristics

Using descriptive statistics, variation in rates of identification among patients of different socio-demographic characteristics were evaluated, including gender, age, and race/ethnicity. Overall documentation of overweight/obese was more likely in males (p=0.03). Diagnosis of overweight was higher in females, but it was almost twice as likely that an obese male would be documented as such as an obese female (Table 1).

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3.3.2 Provider socio-demographic characteristics

Again using descriptive statistics, the variation in rates of identification among providers of different PGY levels as well as NP was evaluated. No statistical significance was found ($p = 0.8034$) based on PGY 1, 2, 3, 4, or NP status in terms of properly diagnosing patients as overweight or obese (Table 1).

3.3.3 Quality of obesity-related EHR documentation

An obesity diagnosis was documented discretely more than twice as often as a diagnosis of overweight. Results showed a statistically significant difference in discrete vs. free text documentation overall ($p = 0.0350$), which remained statistically significant for overweight ($p = 0.01$ but not obese patients ($p = 0.61$).

CHAPTER 4

DISCUSSION

4.1 Summary of Findings

The results of this research provide a snapshot of the current state of EHR obesity diagnosis documentation in a metropolitan pediatric resident group practice clinic. We found that 72.2% of overweight/obese children treated at the clinic had some form of diagnosis documentation. Thus, despite the fact that the EHR automatically calculated BMI for all well child visits where height and weight are entered (which was 100% of visits), this still leaves 27.8% of patients who had no diagnosis of being overweight or obese in their chart. Although far from perfect, the 72.2% documentation rate in our study is far superior to the 53% and 20.5% rate seen in the aforementioned paper chart studies. In the prior study of North Carolina Medicaid enrollees, BMI was recorded only 22% of the time, plotted on growth charts only 24% of the time, and documented as a diagnosis only 10% of the time for 3 to 5 year olds and recorded only 21% of the time, plotted on growth charts only 20% of the time, and documented only 12% of the time for adolescents. In our EHR-based study, the BMI was recorded and plotted on growth charts 100% of the time with diagnosis documentation 72.2% of the time. Thus, EHRs appear to have great potential as a clinical decision support tool to aid providers in recognizing overweight/obesity when it exists so that they can better track and diagnose overweight and obese patients, ordering appropriate screening tests and referring to specialists as necessary. With the 2013 eligible provider (EP) Meaningful

Use Core Objective requiring the provider to record and chart changes in height, weight, and blood pressure, calculate and display BMI, and plot and display growth charts for children 2–20 years there will hopefully be widespread improvement across the country. .

Despite this increase compared with paper documentation, the fact that nearly 25% of patients were not properly labeled as overweight or obese despite automatic BMI calculation by the EHR, suggests current use of clinical decision support around BMI in EHRs may be far from optimal. Our study did not explore why physicians failed to document patients as overweight/obese, but factors, such as over-riding co-existing health issues may impact this diagnosis. A parent may bring a child to a well-child visit with many concerns they wish to address aside from obesity or the patient may have other co-morbidities that receive focus during the visit. Additionally, fear of labelling, lack of EHR-usage training, and/or absence of training in the diagnosis itself may underly our findings. Dietz et al. speaks to this in a recent publication in The Lancet, noting that health professionals are poorly prepared to address obesity due to biases, a lack of understanding of obesity, a lack of training in behavior change methods, and inexperience working within interprofessional teams. Published reports of treatment and randomized trial for pediatric patients are lacking. Dietz notes that the use of technology may benefit patients with overweight and mild to moderate obesity. (26) Significant change is required if primary care practices are to spearhead the move to decrease childhood obesity and chronic disease. This change will require identifying and addressing specific knowledge and skill gaps on the part of the provider. (27)

Interestingly, more overweight children than obese were missing diagnosis documentation. It may be that providers are relying on their "gut sense" of how a child looks, rather than actual growth curves, to make diagnoses, and therefore fail to recognize the overweight child but recognize the obese child. This is worthy of further exploration. A web-based survey using photographs and questions was distributed to healthcare providers at a university-based hospital to assess healthcare providers' ability to estimate women's body mass index (BMI) based on physical appearance and determine the prevalence of, and barriers to, weight-related counseling. Results of the survey showed that healthcare providers are inaccurate at appearance-based BMI categorization and thus, BMI should be routinely calculated in order to improve identification of those in need of counseling. Further review is needed to determine if pediatricians also may be missing overweight diagnosis based on appearance alone. (28)

Among those patients who do have overweight/obese diagnosis present in the EHR, most documentation occurred in the Progress Note. With only 45.9% of diagnosis done with ICD-9 billable codes, there is a significant potential for loss in obesity-related state funding unless this diagnosis is coded. Screening of children age 6 years and older for obesity and offering them or referring them to comprehensive, intensive behavioral interventions to promote improvement in weight status is a U.S. Preventive Services Task Force (USPSTF) Grade B recommendation. The Affordable Care Act includes provisions that allow for enhanced federal funding for states that conduct this screening and counseling. (29) Additionally, with Problem List documentation minimal (17.2%), an important opportunity to maintain easily

retrievable diagnostic record of overweight/obese is lost. Adam Wright conducted research on problem inference alerts in the electronic medical record. He noted that this clinical decision support increased the documentation in the problem list, potentially improving quality of care. (30) Further studies should examine physicians' perception of the utility of the problem list for follow-up of potential overweight/obesity complication risk and the reason for minimal usage. At Columbia University Medical Center, in an effort to align ICD diagnosis documentation with Problem List documentation, an integrated billing application was created within the commercial EHR environment to streamline clinicians' documentation and billing workflow and simultaneously populate the inpatient problem list using billing diagnosis codes. The application created a technological solution to flow billing data to clinical documentation, serving the needs of busy providers. The success of the application provides evidence of the potential for innovative solutions within the EHR. (31)

Even among those who have a documented diagnosis of overweight or obese, only 54.7% of children aged ≥8 years received follow-up laboratory testing, an American Academy of Pediatrics recommendation. Almost ¾ of the overweight children (70.6%) did not receive laboratory testing. This is a concern as it suggests a loss of potential opportunity to capture necessary diagnostic information at an early stage. As far back as 2007, Expert Committee recommendations were released to facilitate management of pediatric overweight/obesity. Subsequent to these recommendations, a 2008 study conducted at a Massachusetts multisite group practice showed that a large majority of children 2 to 17 years old with a BMI ≥85th percentile

lacked diagnosis codes for overweight/obesity and recommended laboratory orders for assessment of obesity-related comorbidities for children 10 years and older. Our study as well shows this documentation and follow-up remains lacking, particularly in the overweight cohort, suggesting a need to increase compliance with guidelines. (32)

Additionally, only approximately ¼ (26.8%) of patients had documentation that they were given in-office nutrition guidance and less than half of the subjects were referred to nutrition counseling. While it is unclear whether providers did not give patients nutrition guidance, or whether they failed to document that guidance was provided, there may be important opportunities lost if nutritional guidance is not provided to overweight/obese patients in the primary care setting. While this study did not differentiate between overweight and obese in regard to counseling given, an earlier study showed overweight boys and girls were counseled at a much lower rate than those who were obese. (33)

Comorbidities were already present in 18.7% of study subjects, with a predominance among the obese children. Three overweight children and 6 obese children already presented with elevated blood pressure. An elevated HgA1c was exhibited in 4 overweight and 5 obese subjects. The Agency for Healthcare Research and Quality (AHRQ) points to trends in the five most costly conditions among the U.S. Civilian Noninstitutionalized Population, 2002 and 2012 in Statistical Brief #470, published April 2015. One of these conditions, heart conditions, accounted for the highest total spending in both 2002 and 2012. Elevated blood pressure and elevated HgA1c, already visible in childhood in our study, are potential precursors to heart conditions and impact healthcare expenditure. Mean expenditures per person with expenses for

heart conditions were ($4,243 and $4,349 respectively) in both years. (34) It is vital to recognize the extent of consequences that are linked to pediatric obesity in order to properly address prevention. (35)

Lastly, our study was conducted among resident trainees. Residency training is a critical time during which providers learn the habits and skills that they will carry forward in subsequent practice. Thus, suboptimal training and education on how to most effectively utilize the clinical decision support (CDS) in EHRs such as for obesity recognition may lead to lifelong deficiencies in this practice. The fact that there was no variation in PGY level reinforces the idea that this is not simply a knowledge piece about obesity (for which you would expect improvement over time), but rather a systematic way of practicing that needs to be addressed early on in training and reinforced over time. (28)

4.2 Limitations

This study was limited by the small study size (N=209). As a retrospective chart review, data collected was limited to existent EHR documentation only. Quantitative in nature, the study lacked an understanding of why providers act as they do in a specific set of circumstances. Further qualitative research is necessary to determine the reasons for socio-demographic differences and limitations in documentation. In addition, this study was conducted at only a single center, limiting generalizability. Larger studies at additional centers are necessary to further advance this field of research.

4.3 Conclusion

Usage of the EHR appears to have improved the ability of providers to recognize and appropriately document a diagnosis for patients who are overweight or obese compared with historical control providers using paper documentation, but there remain significant improvements needed. Expanded provider training on effectively utilizing the potential of EHRs to improve obesity management appears critical. The need exists to continue research in this area, as the potential for improved diagnosis is vital to improvements in quality of life for millions of patients and for reduced healthcare spending.

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